FIG.1
PRIOR ART

VCO 10 S_1

CONTROL 12 V

14 S_1 16

20 18 S_1 22

SIGNAL TRANSFORMER

S_2

30 S_2 26 24

S_3 32

SIGNAL PROCESSOR $f_i(a_i, \phi_i)$ MEM. 34 μP 36 38

FIG.2
PRIOR ART

40 42 20

18 T_N (f) A_N (f) I_N

S_1 T_1 (f) A_1 (f) I_1 COMBINE S_2 24

T_0 (f) A_0 (f) I_0

40

FIG.3A
PRIOR ART

MHZ

925 44

915

905

t (ms)

|←16ms→| .67

FIG.3B

925
915
905

$125\mu s$ 46 t_O 47 TN 49 48 Δf_N t_R

16 ms

.67 ms

FIG.4

$a_0 \phi_0$ — f_O
$a_1 \phi_1$ — f_1
$a_2 \phi_2$ — f_2

S3

$a_D \phi_D$ — f_O
$a_E \phi_E$ — f_E
$a_F \phi_F$ — f_F

FIG.5

S2

Σ S2

38

$I_0(O_0)$ $I_1(O_1)$ $I_2(O_2)$ $I_{N-1}(O_{N-1})$ $I_N(O_N)$

S1

T_O 50 ΔT 50 ΔT ΔT ΔT 50

FIG.7

74
80 84 84 84 80
76

FIG.6

72

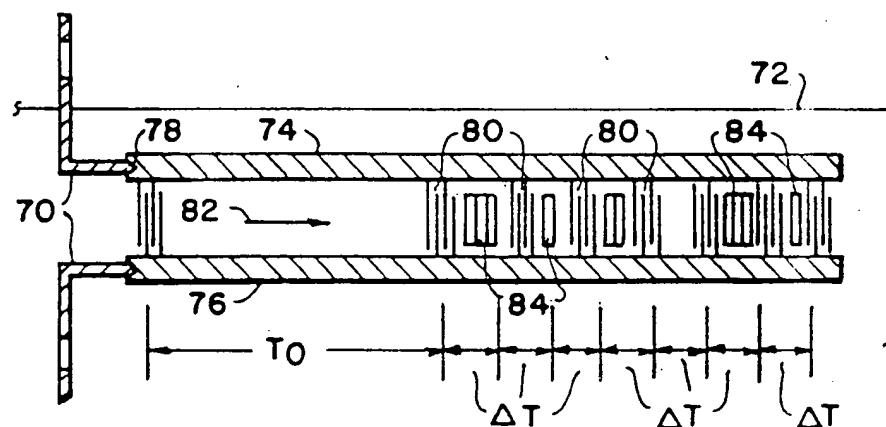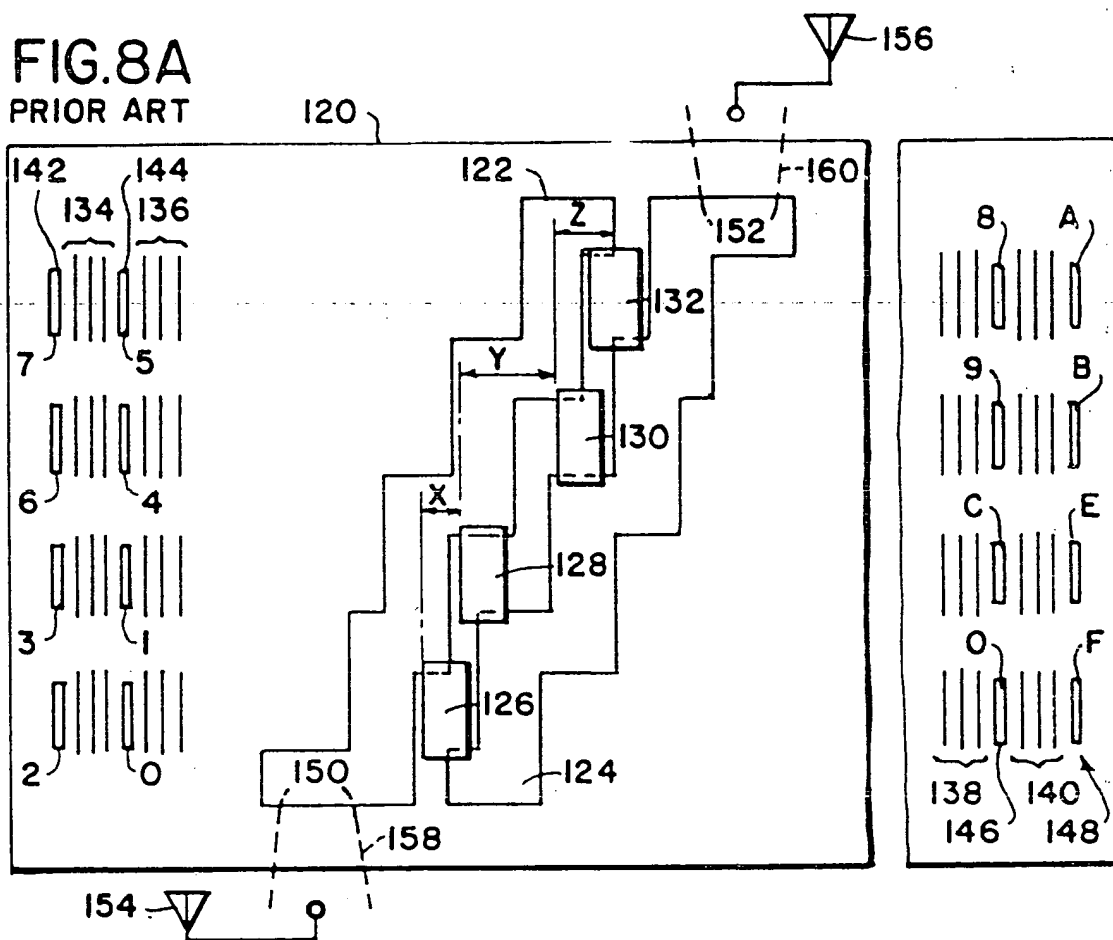78 74 80 80 84

70

82 84

T_O 84

ΔT ΔT ΔT

FIG.8A
PRIOR ART

FIG.8B
PRIOR ART

FIG.9A

Bt

ΔT

FIG.9B

Bx

Tf INFORMATION CELL DISTRIBUTED OVER TIME Tl
AND FREQUENCY

FIG.9C

Tl−Tf

3μs   23μs

902MHz

INFORMATION CELLS DISTRIBUTED OVER TIME ONLY

FIG.IOA

IMAG   ENCODED LOCATION
FOR INFORMATION
CELL

REAL
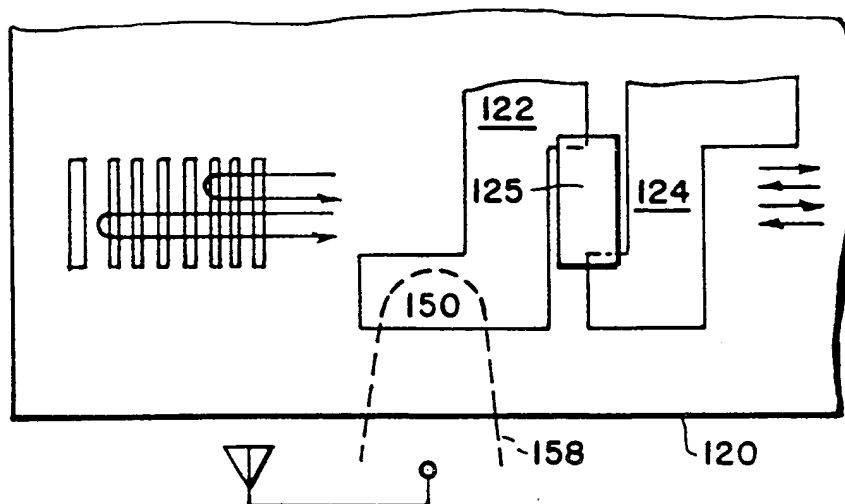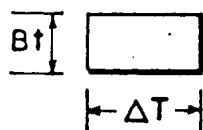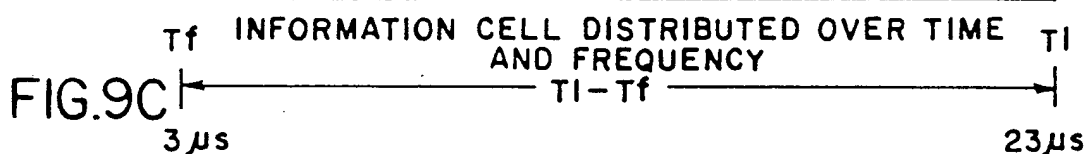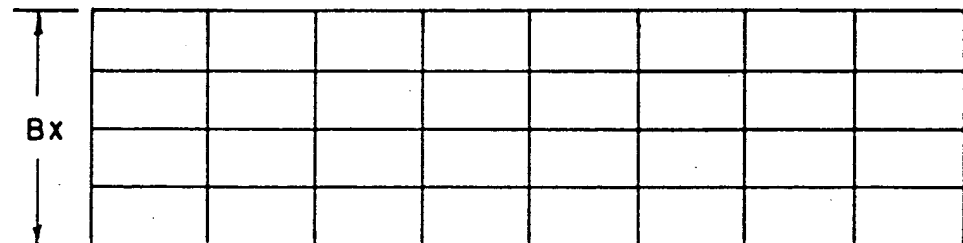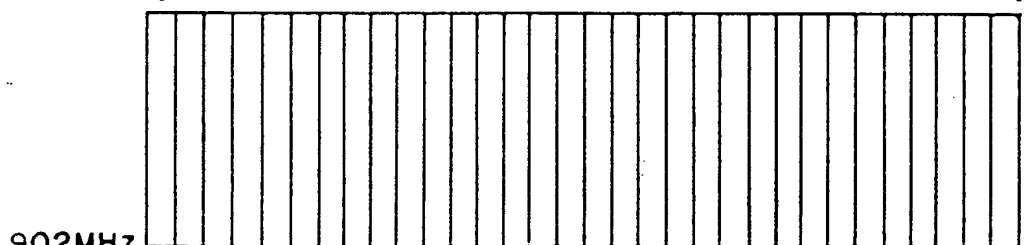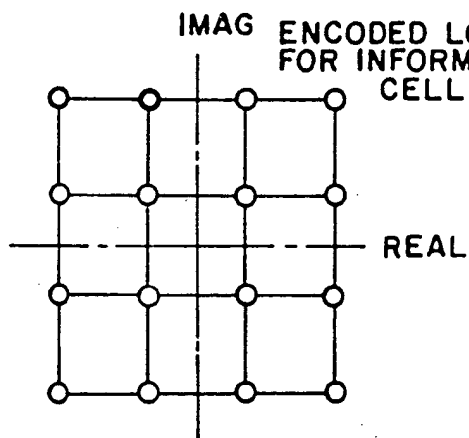
QAM (16) ENCODING
RECTANGULAR MODULATION

FIG.IOB

IMAG   ENCODED
LOCATION
FOR
INFORMA
-TION
CELL

#I

REAL
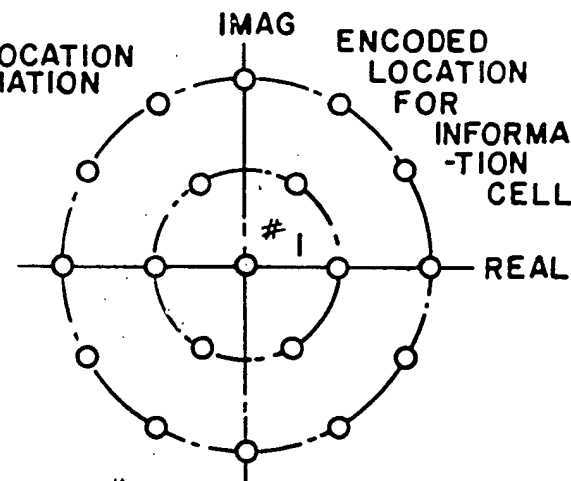
#I CELL NOT USED
QAM (18) ENCODING
POLAR MODULATION
(BETTER SUITED SAW APPLICATION)

FIG.11A

FIG.11B

3

4   1   2

5
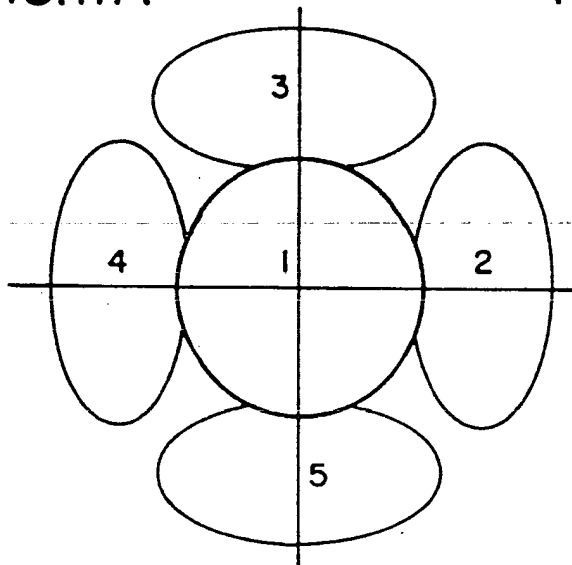
BEAM PATTERN COVERAGE USING PATCH
LIKE ANTENNA (PROJECTION VIEW)
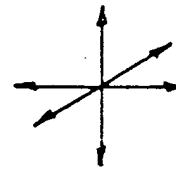
POLARIZATION AXES
POLARIZATION COVERAGE

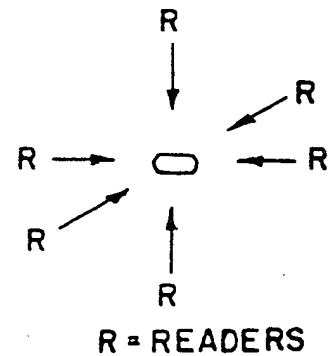SPATIAL DISCRIMINA
-TION MULTI-READ
POINTS
SPATIAL COVERAGE

FIG.11C

R

R

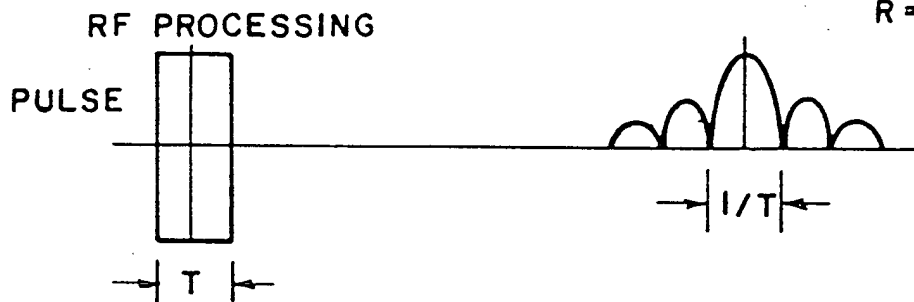R → ▭ ← R
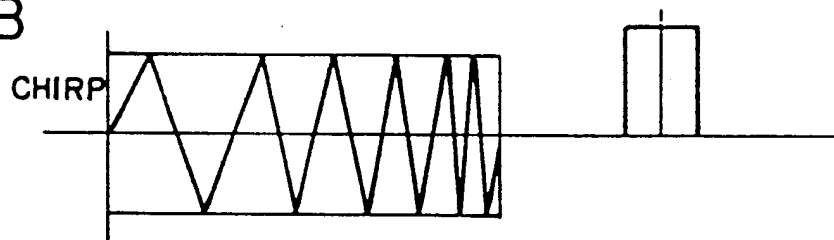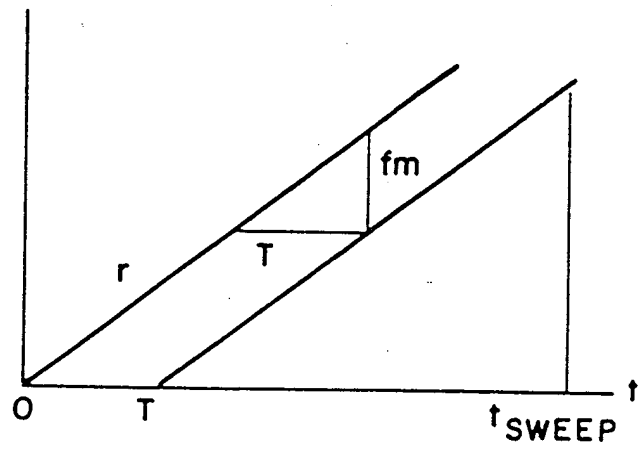
R

R

R = READERS

FIG.12A

RF PROCESSING

PULSE

$\leftarrow$ T $\rightarrow$

$\rightarrow$ I/T $\leftarrow$

FIG.12B

CHIRP

FIG.12C

CHIRP
IMPULSE   (AFTER WEIGHTING APPLIED)

$\leftarrow$ T $\rightarrow$

FIG.I2D

$fm = Tr$

t_{SWEEP} = SWEEP TIME

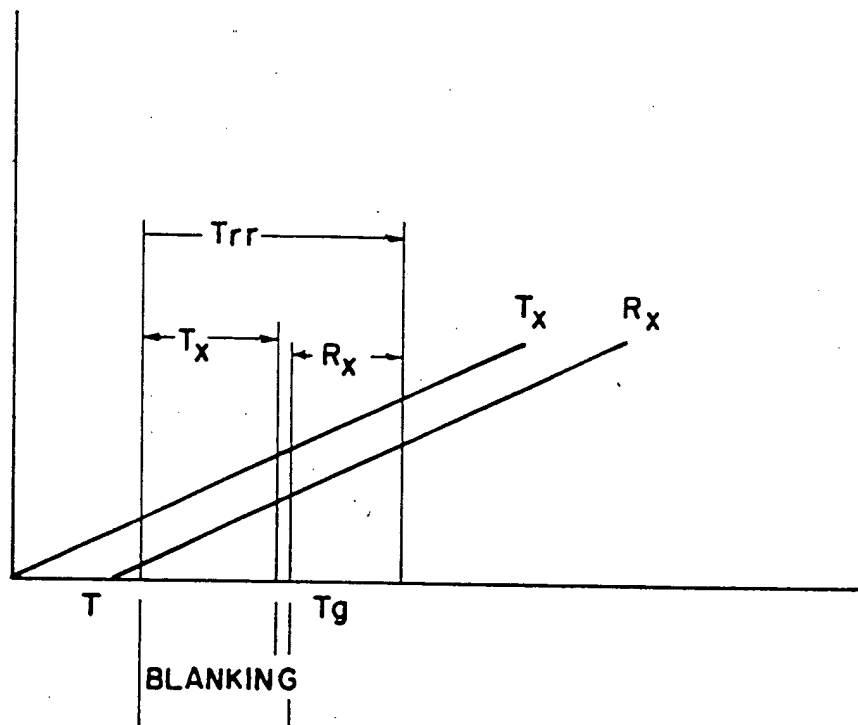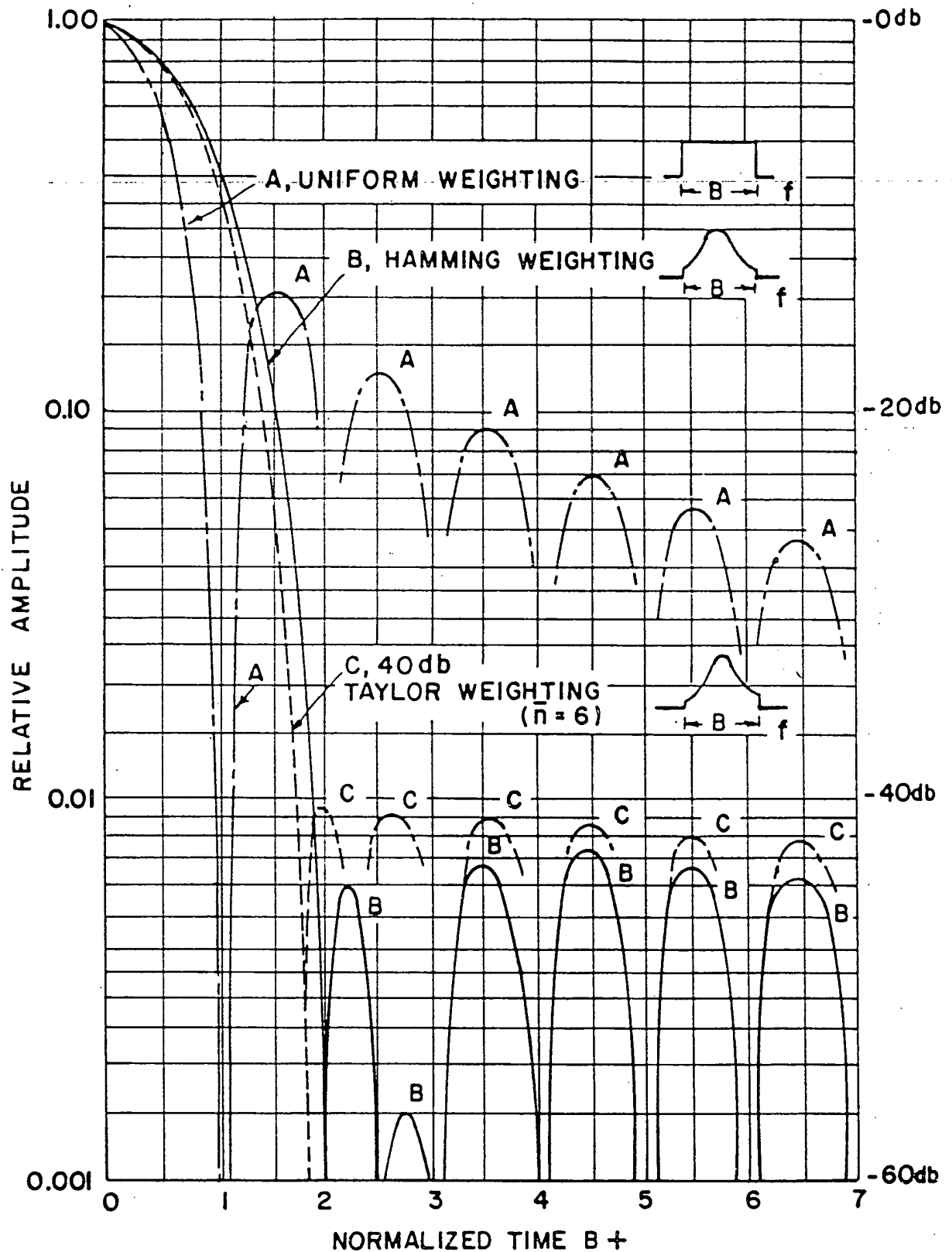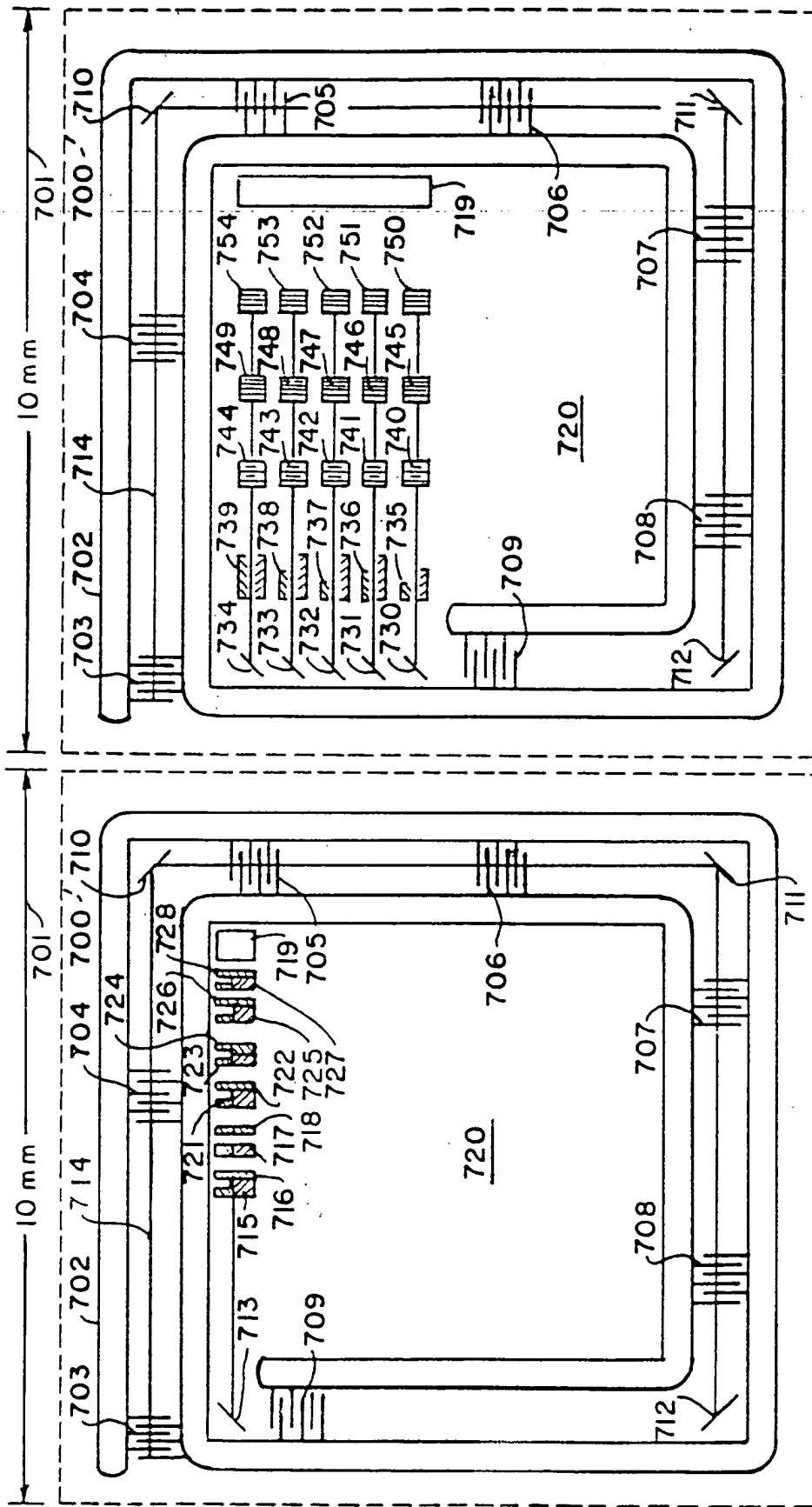$1/t_{SWEEP}$ = NOISE BANDWIDTH OF DETECTOR

FIG.I3

FIG.14

FIG.16

FIG.15

||||| TRANSDUCER SELECTED FOR I OF Nf FREQ BANDS
/ HIGH EFFICIENCY CORNER REFLECTOR
⊠ AMPLITUDE WEIGHTED DELAY PAD
▯ BROAD BAND PARTIAL REFLECTOR

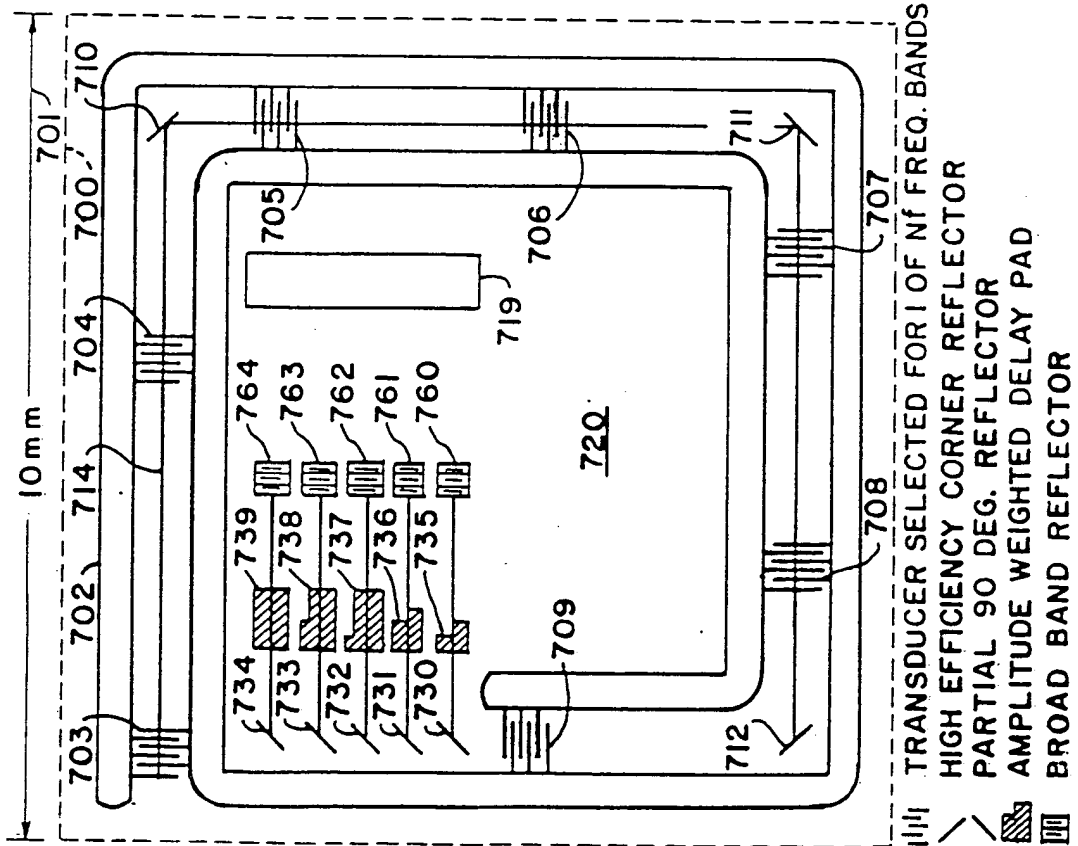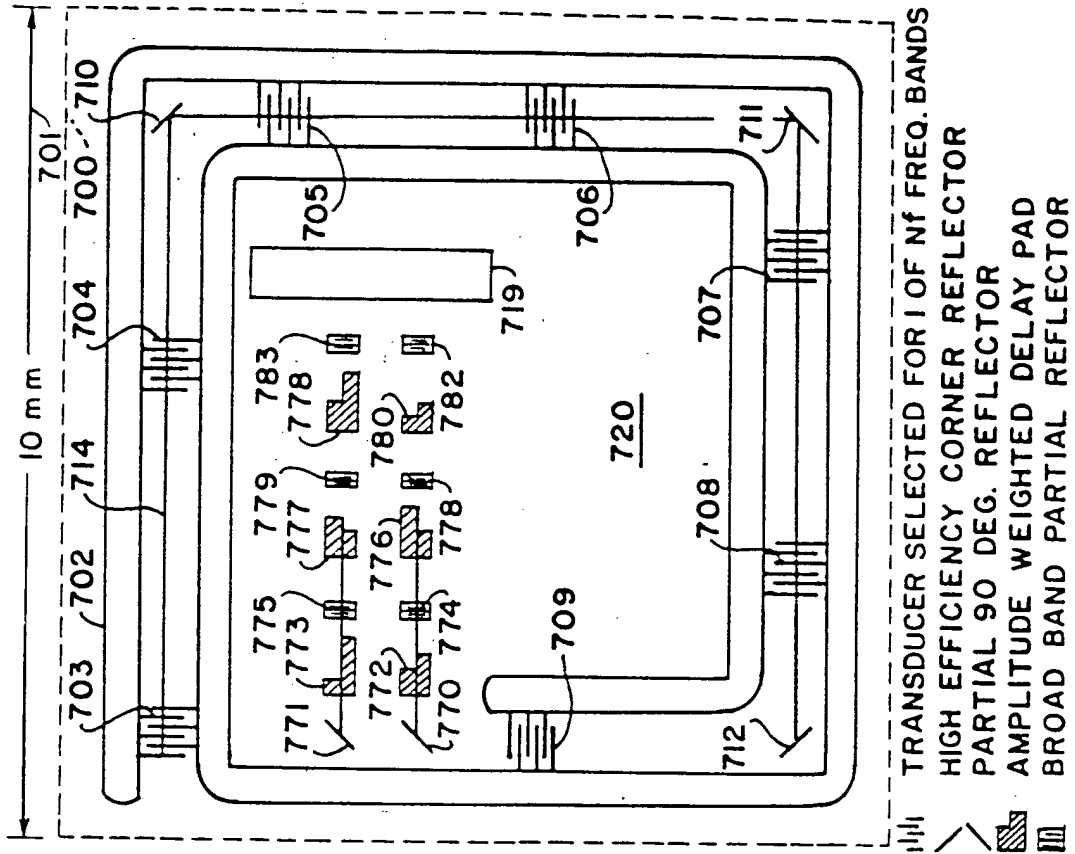||||| TRANSDUCER SELECTED FOR I OF Nf FREQ. BANDS
/ HIGH EFFICIENCY CORNER REFLECTOR
/ PARTIAL 90 DEG. REFLECTOR
⊠ AMPLITUDE WEIGHTED DELAY PAD
▦ FREQUENCY SELECTIVE REFLECTOR

10mm

775 779 783
771 773 777 778
772 776 780
770 774 778 782
769
720

703 702 714 704 700 701 710
700 710
705
704
719
706
707
708
711
712

TRANSDUCER SELECTED FOR I OF Nf FREQ. BANDS
HIGH EFFICIENCY CORNER REFLECTOR
PARTIAL 90 DEG. REFLECTOR
AMPLITUDE WEIGHTED DELAY PAD
BROAD BAND PARTIAL REFLECTOR

FIG.18

10mm

734 739
733 738
732 737
731 736
730 735
764
763
762
761
760
769
720

703 702 714 704 700 701 710
700 710
705
704
719
706
707
708
711
712

TRANSDUCER SELECTED FOR I OF Nf FREQ. BANDS
HIGH EFFICIENCY CORNER REFLECTOR
PARTIAL 90 DEG. REFLECTOR
AMPLITUDE WEIGHTED DELAY PAD
BROAD BAND REFLECTOR

FIG.17

FIG.19A

800

801
802
803
804
805
806
807
808
809
810

FIG.19B

844

820
821
823
824
837
836
835
825
826
827
828
834
833
829
830
831
832
839
839
840
841
842
843

FIG.19C

850

851
853
855
864
860
858
862
863
857
861
859
854
852
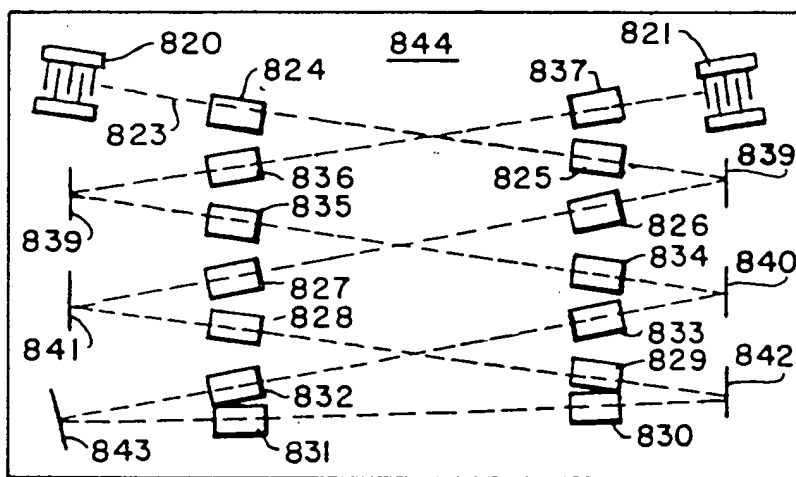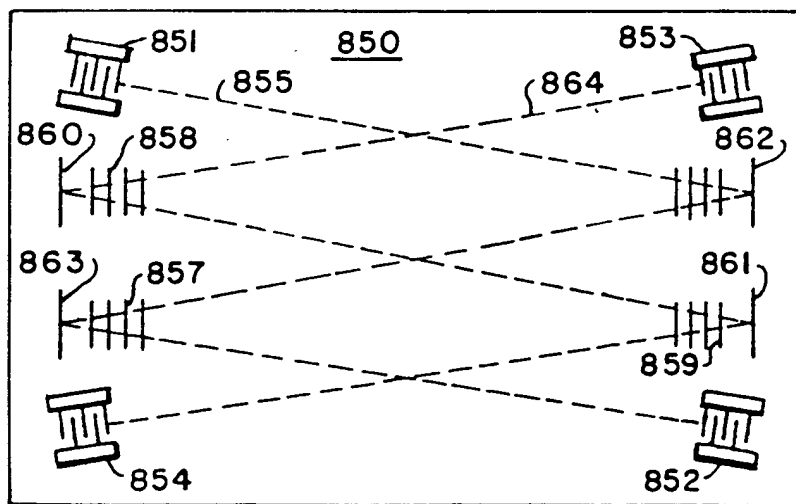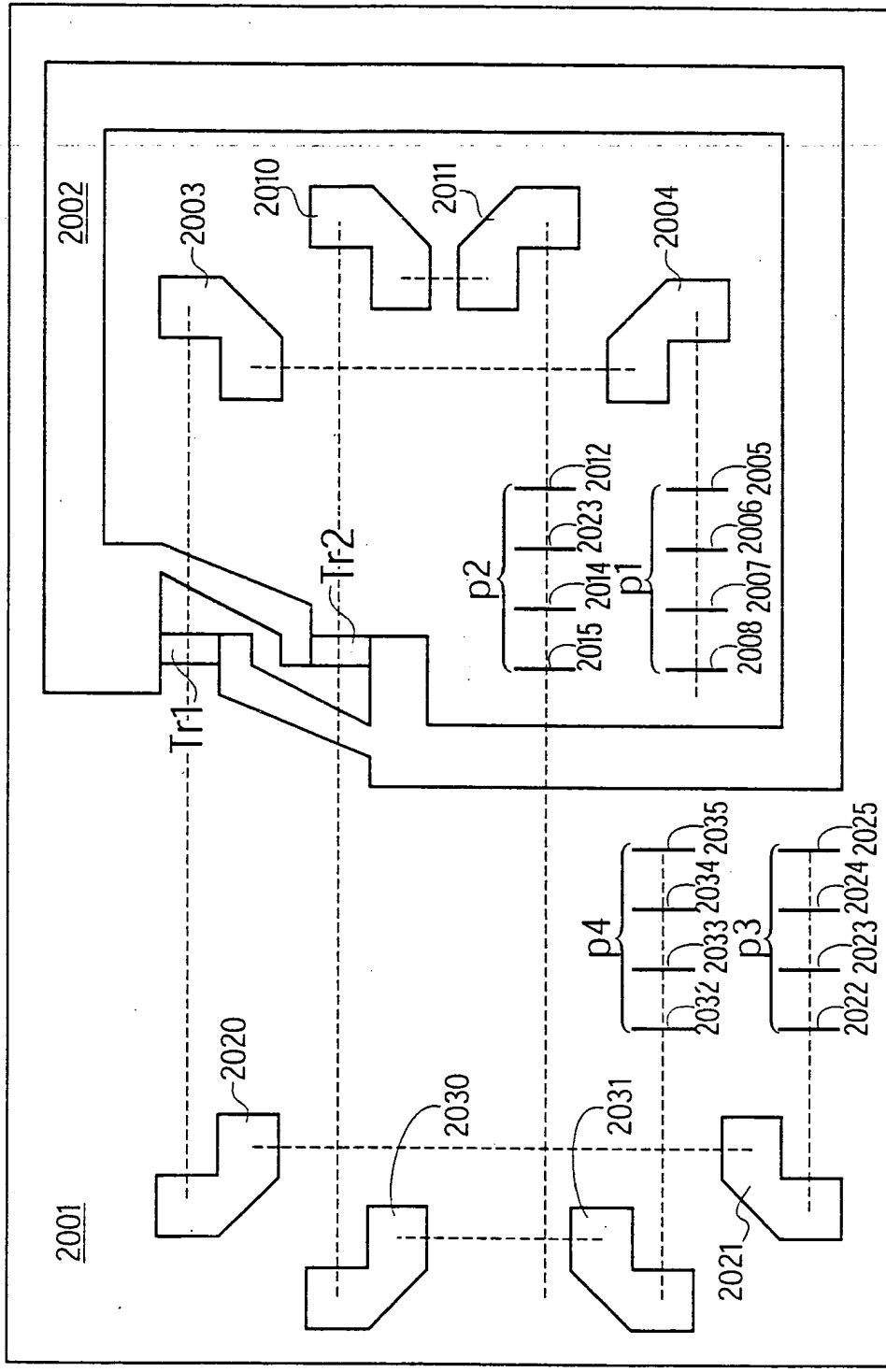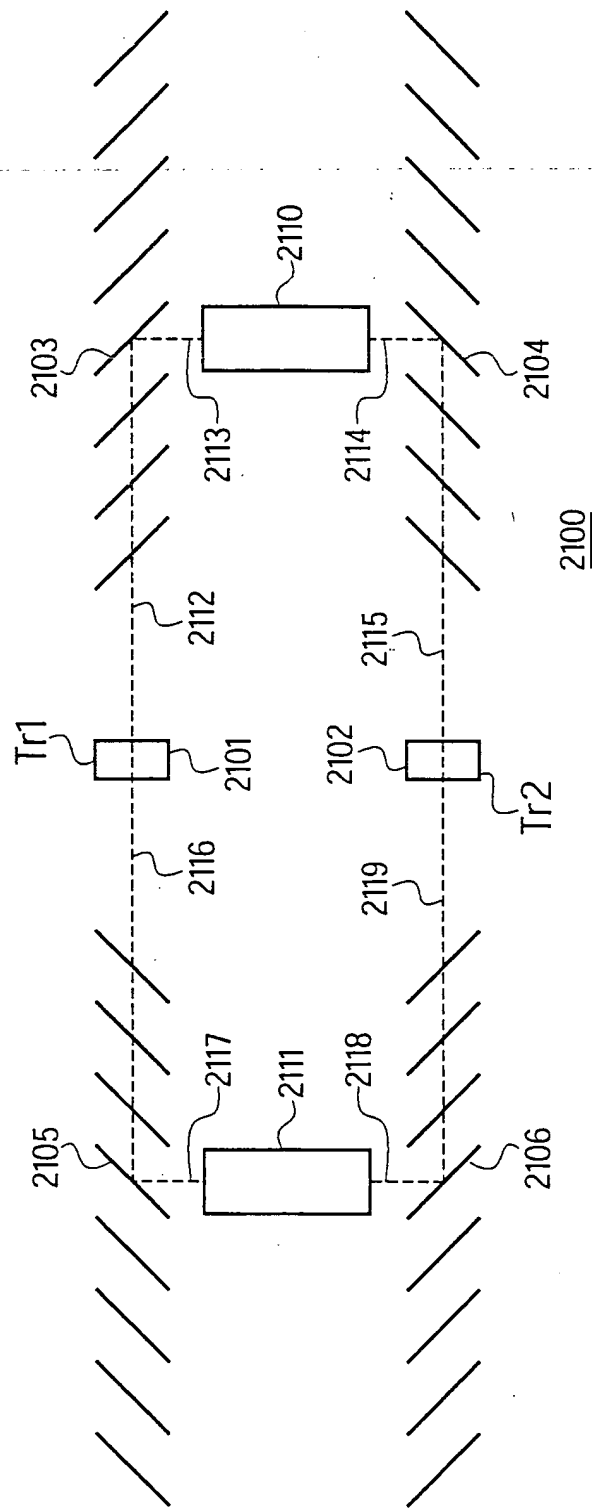
Fig. 20

Fig. 21

Calculation of element reflection and resultant loss per tap (excluding transducer loss) for 16 tap RAC. (8 taps on each side of transducers)
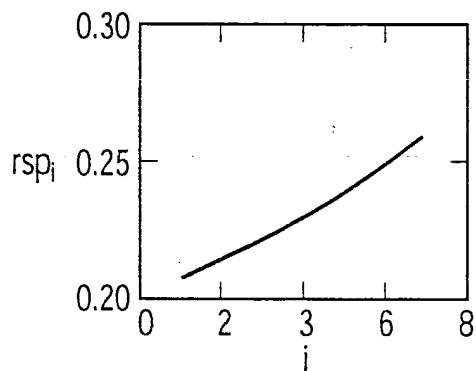
Parameters: top = prop. loss between taps (200ns delay)
rsp0 = refl. coeff. of 1st tap (one RAC element)
rl0 = prop. loss of first tap (1 μs delay)(dB)

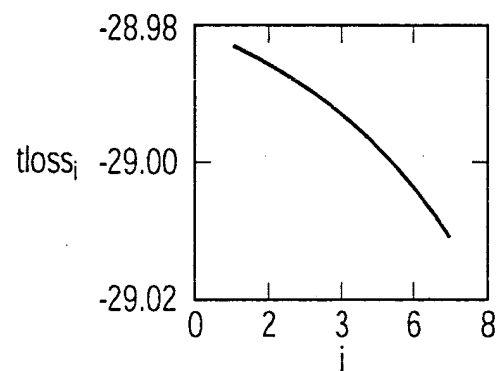$$top := 0.977 \qquad rp_0 = 0.04 \qquad rl_0 := 1.0 \qquad rsp_0 := \sqrt{rp_0}$$

$$i := 1..7 \qquad rp_i := \frac{rp_{i-1}}{1 - rp_{i-1}} \cdot \frac{1}{top} \qquad rl_i := (1 - rp_i) \cdot top \cdot \frac{rp_i}{rp_{i-1}} \qquad rsp_i := \sqrt{rp_i}$$

$$tloss_i := 20 \cdot \log(rl_i \cdot rp_0) - 1.0 \qquad tloss_0 := 20 \cdot \log(rp_0) - 1.0$$

$$rsp = \begin{bmatrix} 0.2 \\ 0.207 \\ 0.214 \\ 0.221 \\ 0.229 \\ 0.238 \\ 0.248 \\ 0.259 \end{bmatrix} \qquad rl = \begin{bmatrix} 1 \\ 0.997 \\ 0.997 \\ 0.997 \\ 0.996 \\ 0.996 \\ 0.995 \\ 0.994 \end{bmatrix} \qquad tloss = \begin{bmatrix} -28.959 \\ -28.983 \\ -28.986 \\ -28.989 \\ -28.993 \\ -28.998 \\ -29.004 \\ -29.011 \end{bmatrix}$$

element reflection as funct. of tap #

Transm. loss as funct. of tap #, dB

Fig. 22

Calculation of element reflection and resultant loss per tap (excluding transducer loss) for 16 tap RAC. (8 taps on each side of transducers)
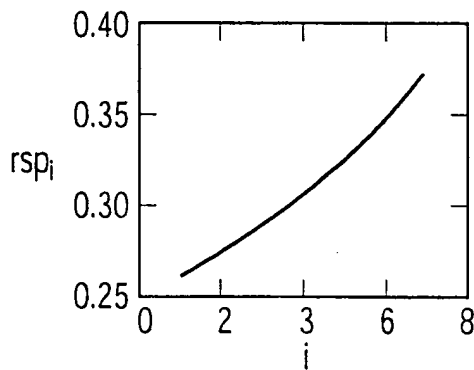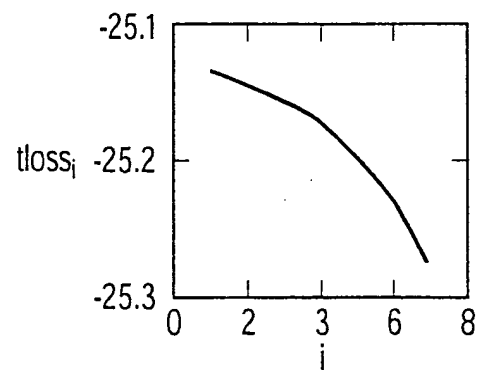
Parameters: top = prop. loss between taps (200ns delay)
rsp0 = refl. coeff. of 1st tap (one RAC element)
rl0 = prop. loss of first tap (1 μs delay)(dB)

$$top := 0.977 \qquad rp_0 = 0.0625 \qquad rl_0 := 1.0 \qquad rsp_0 := \sqrt{rp_0}$$

$$i := 1..7 \qquad rp_i := \frac{rp_{i-1}}{1 - rp_{i-1}} \cdot \frac{1}{top} \qquad rl_i := (1 - rp_i) \cdot top \cdot \frac{rp_i}{rp_{i-1}} \qquad rsp_i := \sqrt{rp_i}$$

$$tloss_i := 20 \cdot \log(rl_i \cdot rp_0) - 1.0 \qquad tloss_0 := 20 \cdot \log(rp_0) - 1.0$$

$$rsp = \begin{bmatrix} 0.25 \\ 0.261 \\ 0.274 \\ 0.288 \\ 0.304 \\ 0.323 \\ 0.345 \\ 0.372 \end{bmatrix} \qquad rl = \begin{bmatrix} 1 \\ 0.994 \\ 0.993 \\ 0.991 \\ 0.989 \\ 0.987 \\ 0.983 \\ 0.978 \end{bmatrix} \qquad tloss = \begin{bmatrix} -25.082 \\ -25.136 \\ -25.145 \\ -25.158 \\ -25.174 \\ -25.197 \\ -25.228 \\ -25.275 \end{bmatrix}$$

element reflection as funct. of tap #   Transm. loss as funct. of tap #, dB
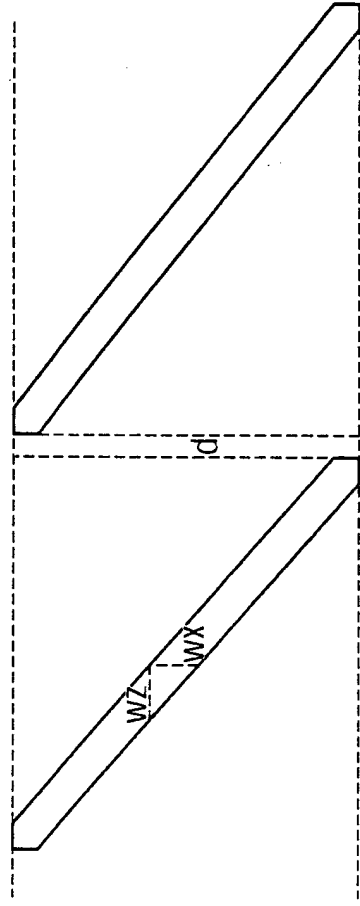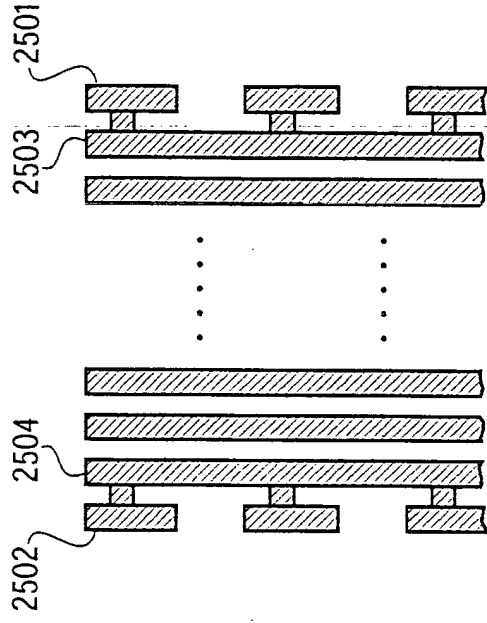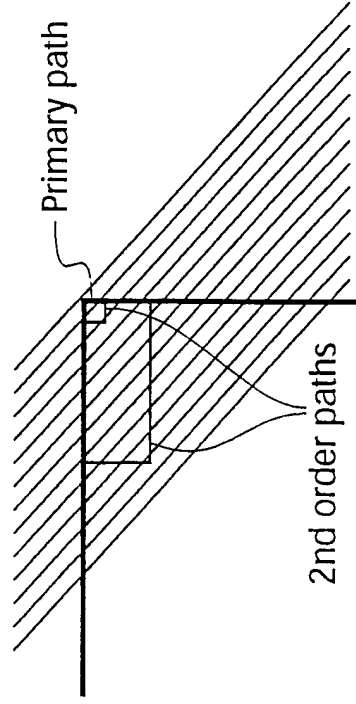
Fig. 23

2501

2503

2504

2502

Fig. 25

WZ

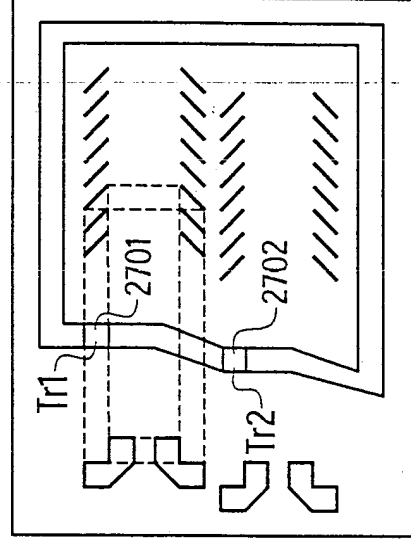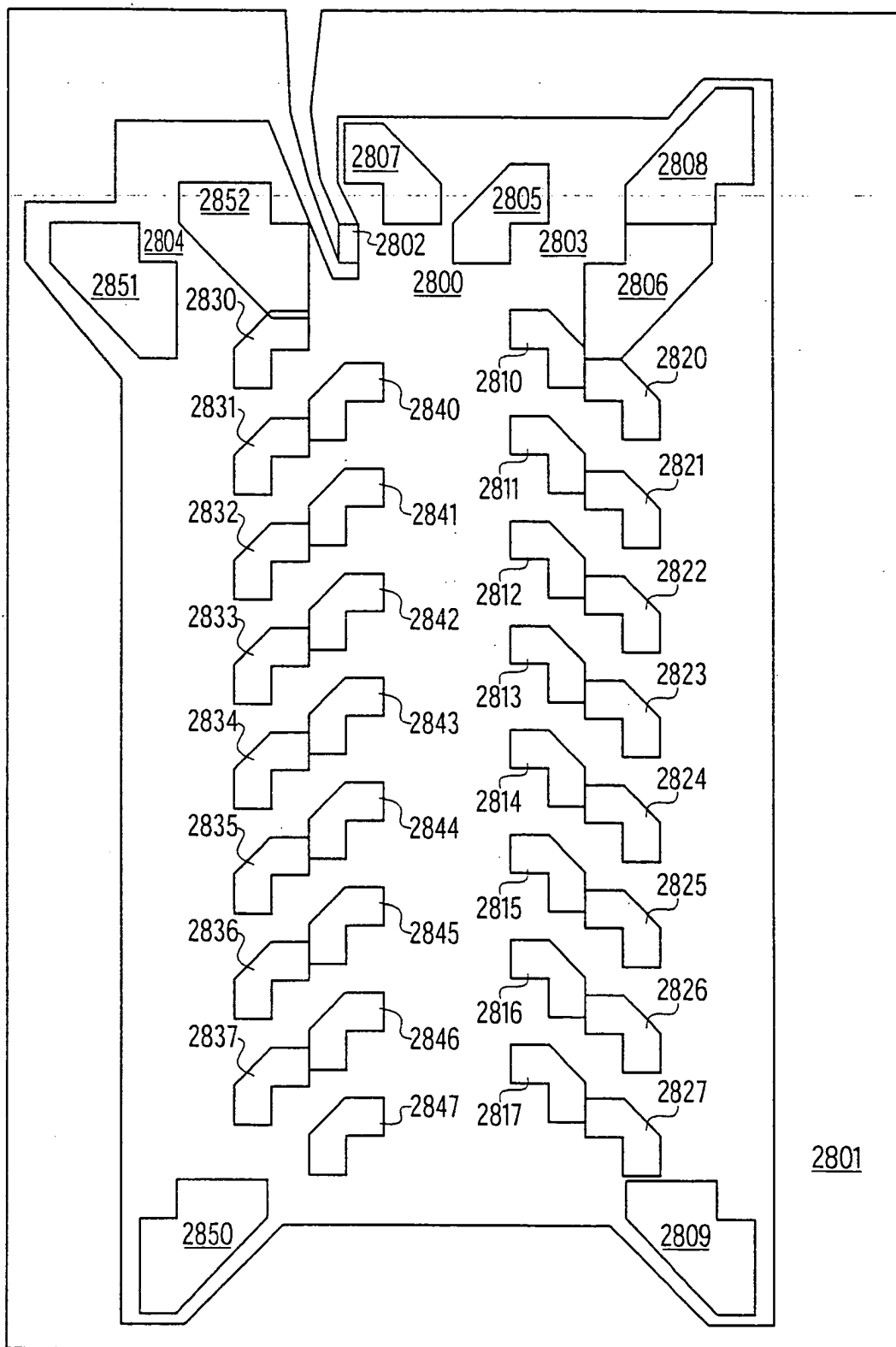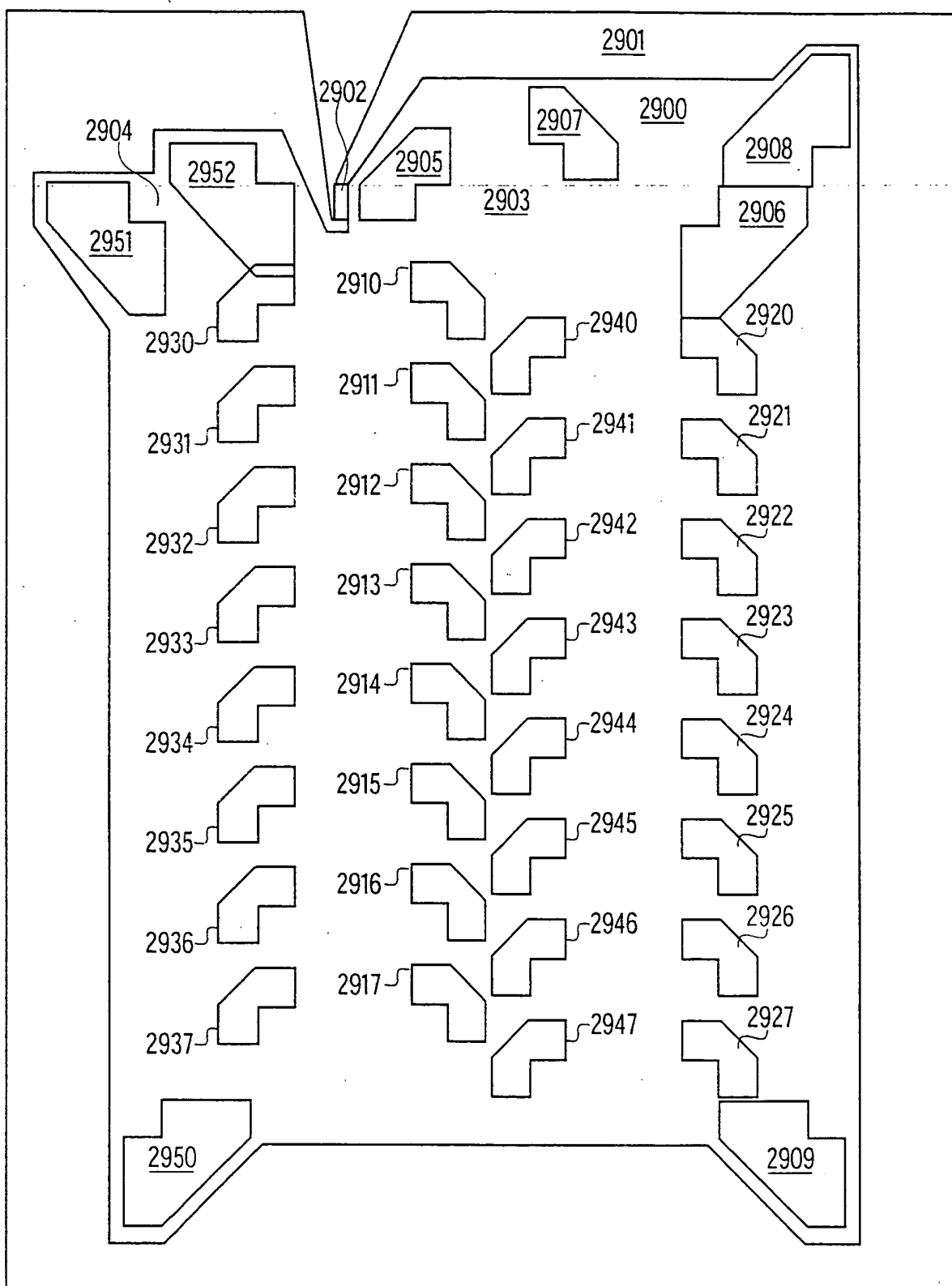WX

d

Fig. 24

2701

2702

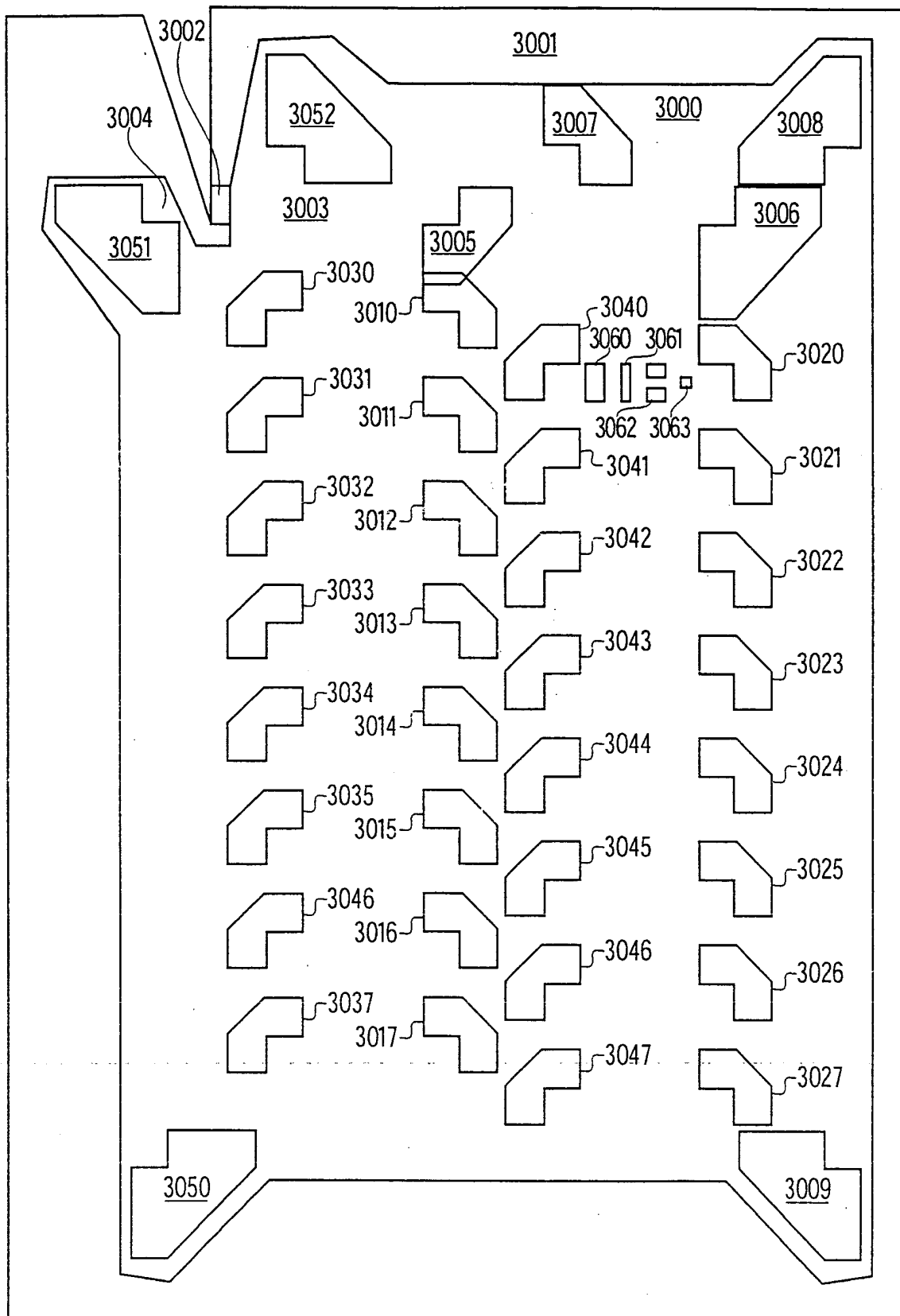Tr1

Tr2

Fig. 27

Primary path
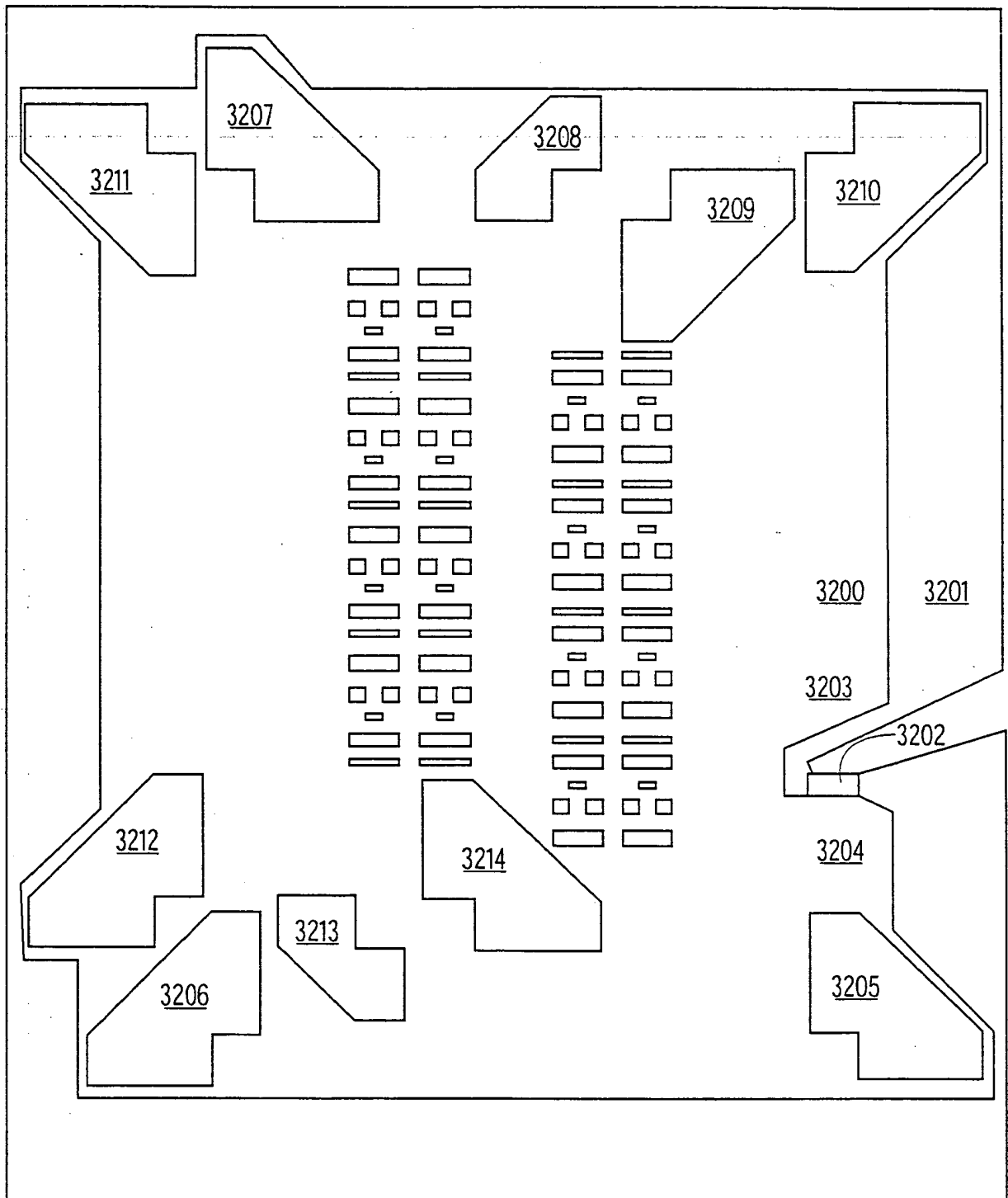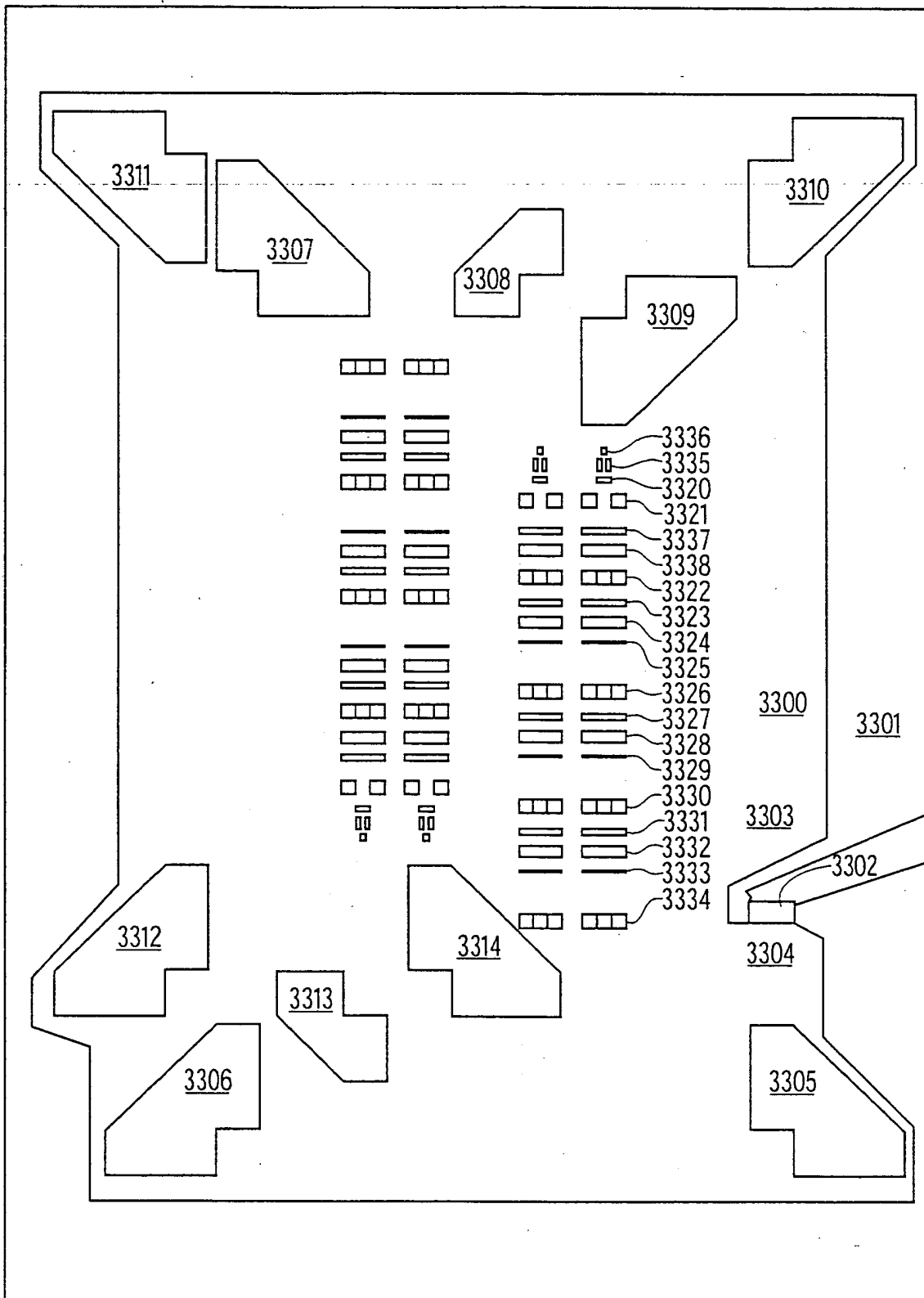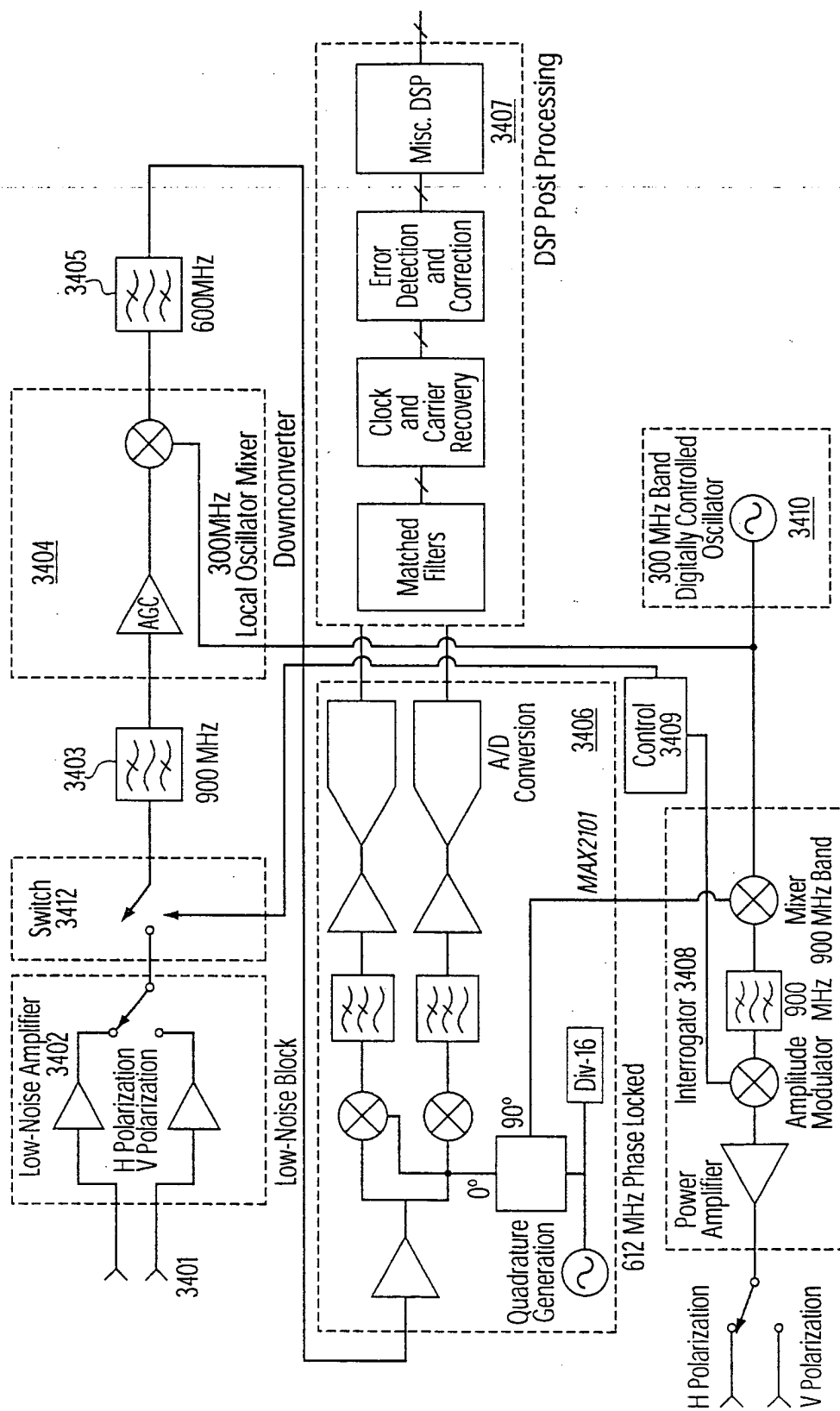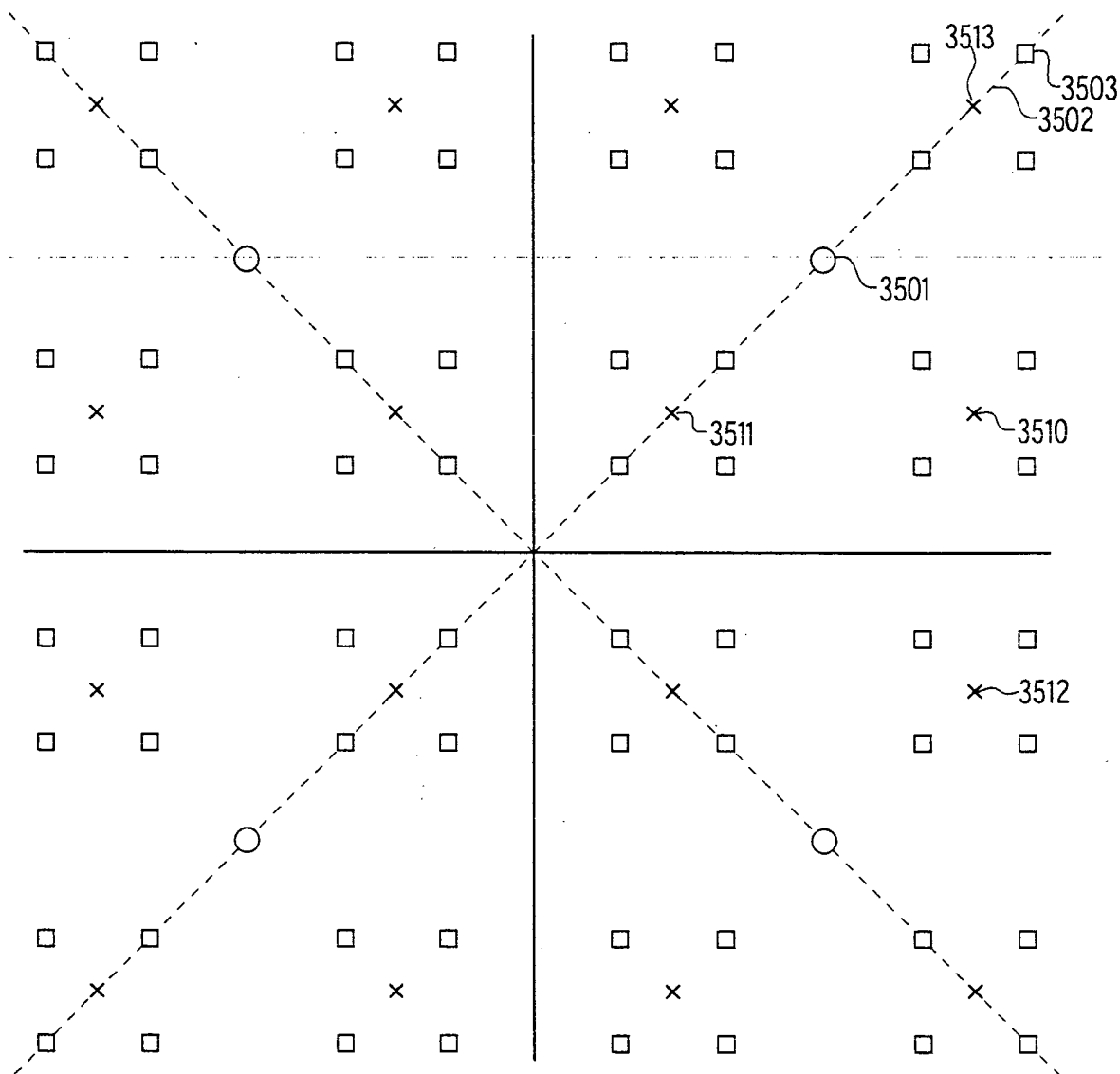
2nd order paths

Fig. 26

Fig. 28

Fig. 29

Fig. 30
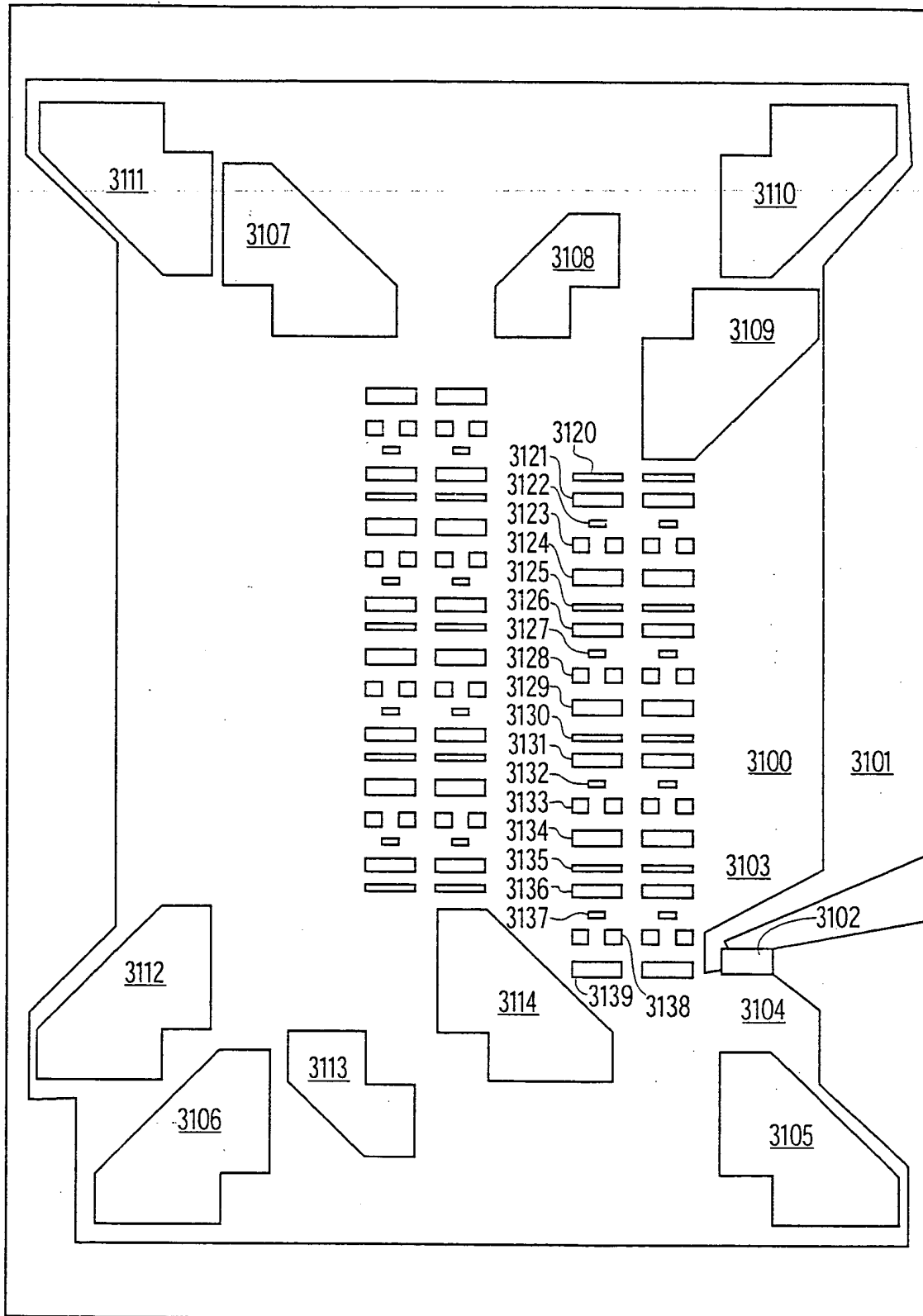
Fig. 31

Fig. 32

Fig. 33

Fig. 34

QAM-64

Fig. 35A

Phase Splitting

$\frac{\pi}{2}$	+	+	−	−
$\frac{\pi}{4}$	+	−	+	−
result	3510	3511	3512	3513

Fig. 35B